case of fracture, to continue from one end to the other; whereas in small blocks, should any such imperfection exist, it cannot extend beyond the limits of its own size: and it will be further seen, that if every other block in every other row was totally destroyed, it would not in any way deteriorate the general support.

Now, supposing these blocks were manufactured by a saw machine, they could be cut with such beautiful accuracy, that no cement would be required to adjust each joint upon an uniform bearing to the other; but as this would incur great expense, it would be doubtless better to set them in Roman cement; and then a well-made brick of the required shape (allowing for shrinking, warping, &c.) would be sufficiently correct, and the cement would in a very great degree counteract the lateral thrust consequent upon the superincumbent weight, which would be further aided, if necessary, by a wrought-iron tie, three-quarters of an inch in diameter, passing through the entire floor, as shewn in the diagram No. 2, at intervals of every 6 or 8 feet. I do not presume to say that a pavement so formed could accommodate itself to the numerous devices of a tesselated pavement, but it would prove an everlasting foundation to one—as lasting, of course, as the walls on which it would rest. Adapted to an area of any extent, either on roadway or in houses, floors may, by the aid of this simple invention, claim a superiority in durability to any that has ever yet been constructed, whilst its predominant advantage may be set forth in an assertion that they would be fire-proof. Not only could each floor of a building avail itself of this mode, but the roof also could, by a slight convexity of the upper surface, and totally supersede the necessity of all that cumbrous and expensive covering that has been in vain modified to the aid of architectural beauty.

To all the advantage of an arch it would add the property of being flat, consequently a gain in height, and a capability of resisting the same pressure upwards as downwards, that is to say in exactly opposite directions. From the last-named quality it will be obvious that a wall or partition so formed would well supply the place of the present dangerous wooden partitions, and being supported on an iron girder would, with the previous suggestions, go very far to make our modern buildings fire-proof, a desideratum too universally admitted to require any comment. I acknowledge this last remark is somewhat irrelevant to the subject upon which I first took the liberty of addressing you, but as the means of effecting each are so intimately connected with one another, I feel assured you will excuse the slight digression, if you but favour me with space in your columns for that which may be deemed interesting to the profession. I also beg leave to send you a model of the blocks, which will more clearly elucidate my remarks.

I am, Sir, &c., R. C. Saunders.

EXPERIMENTAL MODELS.

"Parvis componere magna."

The strength and weight of the building materials at our command being known, the proportions of the parts of a proposed structure, necessary to ensure its stability under the greatest probable stress to which at any time it may be liable, as with regard to a bridge, from a load upon it, may be calculated, sometimes with mathematical nicety.*

If the design be unusual and complicated, and change of form or motion is likely to take place from causes extraneous of the structure, as in a suspension-bridge from the action of a load passing over it, or of the wind, it is well to use a model, as by its means the changes and vibrations of the proposed structure may be more satisfactorily inferred than from the most laborious calculations.

The model may be made of materials the same as—or different from, if more convenient—those intended to be used on the larger scale; but in either case regard must be had to the relative strengths and weights of the materials when put together in the proposed manner, if we wish to make a just comparison of the little with the great structure.

In masses of similar forms and materials, but of dissimilar dimensions, the strengths are as the squares, but the weights (and of course the strains depending upon the weights) are as the cubes of the respective dimensions. For instance, with respect to two rectangular beams laid horizontally, the first 1 foot deep, 1 foot wide, and 20 feet long between the supports, the other 2 feet deep, 2 feet broad, and 40 feet long, the dimensions are as 1 to 2, the strengths as the number of parts in the cross sections which oppose extension, that is, as the areas which are as the squares of 1 and 2, or 1 to 4; the cubical contents, and, therefore, the weights are to each other as the cubes of 1 and 2 or 1 to 8. It thus appears, that while the resisting power and weight (or straining force) of the smaller beam, are to each other as 1 to 1, the resisting force and weight of the greater beam are to each other as 4 to 8, or as 1 to 2. If we suppose that the latter is just so strong as not to bend with its own weight alone acting upon it, the former would bear a load equal to its own weight, uniformly distributed over it, without bending; for then the resisting power and straining force of each would have the same proportion, viz., 1 to 2. In experimenting with a model, care must be taken that this condition is fulfilled.

If we proposed to construct a suspension bridge, or say for the novelty, a tubular bridge, of 450 feet span, with 500 tons of iron, and an experimental model of 45 feet span, the dimensions being as 1 to 10, the cross sections of the great tube would be 100 times greater than those of the model; its weight would be 1,000 times greater, which numbers also are as 1 to 10. To put the model, therefore, upon equal terms with the projected bridge, it would have to be loaded with 9 times its own weight, or with $\frac{500}{1000} \times 9 = 4\frac{1}{2}$ tons; and the same allowance would have to be made for all external disturbing causes, as the weight of carriages, &c.

If we were to form our model of tin, as more manageable on a small scale, we must proceed in the same way to reduce the strengths and strains to the same ratio. The relative strengths of tin and iron to resist extension, are nearly as 1 to 4, and their specific gravities nearly equal. Making the respective dimensions as 1 to x, the strengths are as 1^2 to $4x^2$, and the strains as 1^3 to x^3.

$$1^3 : 1^3 :: 4x^2 : x^3.$$
$$x^3 = 4x^2.$$
$$x = 4.$$

Whence it appears that if the dimensions were as 1 to 4, a bridge of tin of $\frac{450}{4}$, or 112·5 feet span, would be nearly upon the same terms with regard to strength and strain as an iron one of 450 feet span. If we were to make our model of $\frac{112{\cdot}5}{3}$, or 37·5 feet span, we should have to add in our trials only twice its own weight, &c.

If we were to construct the model of lead, the strengths of lead and iron to resist extension being nearly as 1 to 10, and their specific gravities as 11 to 7.

$$1^2 : 11 \times 1^3 :: 10x^2 : 7x^3.$$
$$7x^3 = 11 \times 10x^2.$$
$$x = \frac{110}{7} = 15{\cdot}7.$$

The dimensions in this case are as 1 to 15·7. The span of the model being made $\frac{450}{15{\cdot}7}$, or 29 feet nearly, no extra loading would be required.

The resistance which bodies offer to extension has been alone referred to; the same reasoning, however, applies to the resistance which they offer to compression. A bridge built of chalk might be made to indicate the strength of one built of granite, if the qualities of the two materials were taken into account.

W.

* A practical illustration of this is, that an arch constructed of loose cards, packed vertically between upright abutments, may be *fast* made to stand without any change of form taking place when the centre is removed. This occurs when the curve of equilibrium cuts the middle of the depth of the arch at the vertex, and the extrados at the abutments. The force by which the arch is sustained is the elasticity of the cards producing sufficient pressure against the abutments to prevent the arch from sliding down them. The amount of force necessary to effect this must be first ascertained by finding the co-efficient of friction of the cards, and the rise and span of the arch must be adjusted accordingly. The resistance of the cards is just equal to the elastic force by which they are compressed; the friction generated prevents their slipping. If an arch constructed with the same span but greater rise than this will stand, nevertheless, as soon as the centre is removed, it will change form; the cards will be compressed at the extrados, loose at the intrados towards the abutments, and the reverse at the crown; thus showing partial strains, which in construction should be avoided as much as possible.

PEDIMENTAL SCULPTURE, ST. GEORGE'S HALL, LIVERPOOL.

Several letters have reached us, relative to the intended enrichment of the pediment of St. George's Hall. Mr. Cockerell, it seems, offered to present his design for this purpose (which appeared in the last exhibition at the Royal Academy), on the condition that it should be executed in proper proportion; and the council have accepted the offer, and appointed a sculptor of Mr. Cockerell's nomination. The letters urge that the design was originally made for the Liverpool Custom House, and that its commercial character unfits it for St. George's Hall; further, and this is more particularly dwelt on, they complain that the Liverpool sculptors have not been allowed to compete for the honour of executing Mr. Cockerell's design. As, however, they are anonymous, *ex parte*, and not written with good feeling, we decline publishing them. The cost of the sculpture in question is stated at more than 3,000*l.*

A writer in the *Liverpool Mail*, wherein much correspondence on the subject has appeared, says, when advocating the claims of the local artists,—"It may not be out of place to add, that the gold medal first given by the Royal Academy of London, was awarded to a Liverpool sculptor (Deare). It is well known that *Mr. Gibson* received his education and produced some of his best works in Liverpool*; and, within the last few weeks, a Liverpool sculptor carried away a prize medal and a sum of money, publicly advertised at the Manchester Royal Institution Exhibition of 1846.

RAILWAY JOTTINGS.

We are much pleased to observe, that Mr. Thomas Gray, the interesting author of the Railway System, is now likely to receive a share of the honour and the more substantial benefits due to him, inasmuch as a subscription for a befitting testimonial has been fairly set afloat in the city where he dwells, and where he must be therefore best known, namely Exeter. It is to be hoped that this will be but the central nucleus of a wide-spread recognition of his services——A correspondent of the *Railway Times* suggests the adoption of a hydraulic safeguard against collision, which will operate on the truck or other moveable obstacle on the rails in front, on the principle of Savery's engine, or the syringe, through a small tube in front of the boiler, and passing into it, and fitted with a valve or cock to be opened at the last moment before the anticipated collisinn. The force applied, it is calculated, would operate retroversively on the engine and train themselves, as well as on the obstacle.——The London and South Western Company are now in possession of nearly all the property necessary for the extension of their line to Hungerford Bridge, and preparations are in progress for the immediate commencement of the works. ——"A huge pile of bricks," by some strange oversight, placed right above the tunnel cutting at the Marlands, on the Southampton and Dorchester Railway, and which had taken weeks to convey there, sunk, of course, into the cutting below, and completely blocked up the burrow. "The inclemency of the night" has much blame attached to it; and "the enormous weight," we should think, much more; but most of all, the still more enormous stupidity of loading an incipient tunnel with such a weight. It will cost some time to clear it out for further progress.—— The wind and tide have done considerable damage to the sea wall on the South Devon Railway, between Dawlish and Teignmouth, near what is called the Parson Tunnel, where there is no solid masonry, but a mere dry wall.——It is intended to concentrate several lines of railway in one extensive station at Carlisle. Mr. Tite's estimate of the cost of the erection is 37,982*l.*; and Mr. Errington, the engineer, intimated that to save time and prevent the confusion of two sets of workmen employed by different contractors, it was desirable to avoid competition in the present instance, and make use of the great resources at the command of Messrs. Brassey

* We take this opportunity of mentioning, with much commendation, an excellent engraving, by Mr. Wagstaff, of our eminent countryman, Mr. Gibson, which was published a short time ago.

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